CLAIMS

1. A method of making an extractant material adapted to remove contaminants from fluid waste, comprising:

   i) providing at least one porous molded glass matrix comprising perforated hollow glass crystalline microspheres obtained from fly ash, and

   ii) impregnating said microspheres with an extractant compound.

2. The method of claim 1 wherein said impregnating step comprises dissolving said extractant compound in a solvent and then loading said solvent containing said extractant compound into said microspheres under vacuum.

3. The method of claim 1 wherein said impregnating step comprises:

   (a) dissolving at least one reactant used to make said extractant compound in a solvent,

   (b) loading said solvent containing said at least one reactant into said porous matrix under vacuum,

   (c) drying said matrix,

   (d) dissolving at least one other reactant used to make said extractant compound in a solvent, and

   (e) repeating steps (b) and (c) with said at least one other reactant, to cause said reactants to react and precipitate said extractant compound in situ.

4. The method of claim 1 wherein said impregnating step comprises:

(a) dissolving at least one reactant used to make said extractant compound in a solvent,

(b) loading said solvent containing said at least one reactant into said porous matrix under vacuum,

(c) dissolving at least one other reactant, used to make said extractant compound, in a solvent, and

(d) flowing said solvent containing said at least one other reactant around said microspheres, wherein said at least one other reactant diffuses into said microspheres and said extractant compound is precipitated in situ.

5. The method of claim 2 further comprising evaporating said solvent from said porous matrix, and rinsing said matrix to remove extractant on the outside of the microspheres, followed by evacuating air from said matrix.

6. The method of claim 3 further comprising evaporating said solvent from said porous matrix, and rinsing said matrix to remove extractant on the outside of the microspheres, followed by evacuating air from said matrix.

7. The method of claim 4 further comprising evaporating said solvent from said porous matrix, and rinsing said matrix to remove extractant on the outside of the microspheres, followed by evacuating air from said matrix.

8. The method of claim 2 wherein said extractant compound is ammonium molybdophosphate (AMP) and said solvent is ammonium hydroxide.

9. The method of claim 4 wherein said extractant compound is AMP and said at least one reactant comprises NH_4NO_3 and $(NH_4)_6Mo_7O_{24}$ in a citric acid and water solution, and said at least one other reactant is $(NH_4)_2HPO_4$ in water.

10. The method of claim 2 wherein said extractant compound is octyl(phenyl)-N-N-diisobutyl-carbamoylmethylphosphine oxide (CMPO), and said solvent is selected from the group consisting of acetone and hexane.

11. The method of claim 2 wherein said extractant compound is selected from the group consisting of resorcin formaldehyde resin (RFR) and a tertiary phosphine oxide POR where R = alkyl groups having 5-9 carbon atoms.

12. The method of claim 11 where said tertiary phosphine oxide is iosamyl-heptyl-nonyl-phosphine oxide.

13. The method of claim 1 wherein said extractant material is an ion exchange material.

14. A method of removing radioactive and other hazardous contaminants from fluid wastes comprising:

i) providing a porous molded glass matrix comprising perforated hollow glass crystalline microspheres obtained from fly ash,

ii) impregnating said microspheres with a extractant compound, and

iii) contacting said matrix containing said extractant with said fluid waste.

15. The method of claim 14 wherein said fluid is a liquid.

16. The method of claim 15 wherein said liquid is nitric acid.

17. The method of claim 15 wherein said contacting comprises immersing said matrix in said liquid waste and stirring.

18. The method of claim 15 wherein said contacting comprises flowing said liquid waste through a bed of said matrix.

19. The method of claim 14 wherein said radioactive contaminants comprise lanthanides and actinides, and said extractant compound is selected from CMPO and iosamyl-heptyl-nonyl-phosphine oxide.

20. The method of claim 14 wherein said radioactive contaminants are cesium ions, and said extractant compound is selected from the group consisting of AMP and RFR.

21. The method of claim 14 wherein said step of impregnating said microspheres with a extractant compound comprises:

dissolving said extractant compound in a solvent and then loading said solvent containing said extractant compound into said microspheres under vacuum.

22. The method of claim 21 wherein said extractant compound is AMP and said solvent is ammonium hydroxide, and further comprising drying said loaded microspheres and adding nitric acid under vacuum.

23. An inorganic ion exchange material, adapted to remove radioactive ions from acidic waste liquid, made by:

i) providing at least one porous molded glass matrix comprising perforated hollow glass crystalline microspheres obtained from fly ash, and

ii) impregnating said microspheres with an ion exchange compound.

24. The inorganic ion exchange material of claim 23 wherein said impregnating step comprises dissolving said ion exchange compound in a solvent and then loading said solvent containing said ion exchange compound into said microspheres under vacuum.

25. The inorganic ion exchange material of claim 24 wherein said ion exchange compound is AMP and said solvent is ammonium hydroxide.

26. The inorganic ion exchange material of claim 25 wherein said radioactive ions are cesium ions.

27. The inorganic ion exchange material of claim 25 wherein said radioactive ions are selected from actinides and lanthanides.

28. An inorganic ion exchange material comprising a porous molded glass matrix comprising perforated hollow glass crystalline microspheres obtained from fly ash, wherein said microspheres are impregnated with AMP.

29. The inorganic ion exchange material of claim 28 further containing ions selected from cesium ions, lanthanide ions and actinide ions.